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JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

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Vol. 62 July, 1960 No. 739

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The New England Botanical Club, Inc.

Botanical Museum, Oxford St., Cambridge 38, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of North America and floristically related areas. Price, $6.00 per year, net, postpaid, in funds payable at par in United States currency in Boston; single copies (if available) 60 cents. Back volumes 1-58, with a few incomplete, can be supplied at $5.00 per volume. Volume 59— available at $6.00. Somewhat reduced rates for complete sets can be obtained upon application.

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Subscriptions and orders for back issues (making all remittances payable to RHODORA) should be sent to Albert F. Hill, Botanical Museum, Oxford Street, Cambridge 38, Mass.

Second Class Postage Paid at Boston, Mass.

Printed by
THE LEXINGTON PRESS, INC.
Lexington, Mass.

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NEW ENGLAND BOTANICAL CLUB

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VASCULAR PLANTS ON THE CINDER CONE OF PARICUTIN VOLCANO IN 1958

JOHN H. BEAMAN

The birth of Parícutin Volcano in a cornfield in the state of Michoacán, Mexico, in 1943 has provided an unparalleled opportunity for the study of volcanism and its effects. The eruption immediately attracted the attention of geologists, whereas biological phenomena were given relatively little consideration in the early years of the Volcano. Geological interest has subsided since the eruptive phase ended on March 4, 1952, but problems for the biologist are becoming increasingly evident. During the active period botanical studies were focused mostly at the destructive nature of the volcanic ejecta (Eggler, 1948, 1959) and the manner of preservation of a potential fossil record in the lava and ash (Dorf, 1945, 1951). The colonization by plants and animals of the wholly inorganic deposits of Parícutin now deserves a thorough, long-term scrutiny.

In the summer of 1958, while in Mexico for a study of the alpine flora in that country, I had the opportunity to make a side trip to Parícutin. The primary motive of this visit was to determine whether or not the same pioneer plant species might be involved in primary succession on volcanic deposits of a new volcano as are found in the alpine flora on the older and much larger volcanoes. In addition to age and size distinctions between Parícutin and the mountains with alpine vegetation, there is also a considerable difference in elevation. The cone of Parícutin has a maximum elevation of about 2800 meters, while the lower limit of the alpine flora is mostly above 3900 meters elevation. No species common

to the two areas were found, but the unexpected result of this visit was the discovery that 14 species of vascular plants already had gained a foothold on the cinder cone of Parícutin only six and a half years after volcanic activity had ceased.

For several reasons it appeared that the limited time available for this study could best be spent on the cinder cone. The lava flows, covering nearly 25 square kilometers (Fries and Gutiérrez, 1954), would be very difficult to examine critically in a short while, and much of the pyroclastic ejecta extend for hundreds of kilometers with no well-defined limits. The cone is the most prominent feature of the Volcano, and its age and history are thoroughly documented. It is small enough to allow observations that can be repeated from time to time by independent investigators. Although small, the cone provides a rather wide diversity of habitats. This report is thus concerned with the vascular plant species which are beginning to establish themselves on the cone of Parícutin.

GEOGRAPHY AND GEOLOGY

Parícutin Volcano is located in central western Michoacán approximately 30 kilometers WNW of Uruapan. Two former villages, Parícutin and San Juan Parangaricutiro, were buried by lava early in the life of the Volcano, and now the closest settlement is Angahuan about seven kilometers to the ENE. Parícutin lies in the zone of hundreds of volcanoes which crosses Mexico from east to west between the parallels of 18° and 22° N. latitude. It is situated about 10 kilometers north, on the lower slope, of the long extinct Cerros de Tancítaro which rises to an elevation of 3860 meters. In a report on the volcanoes of the Parícutin region, Williams (1950) indicated that more than 150 cinder cones and over 20 large lava cones were present in the area covered by his geological reconnaissance map (about 50 x 60 kilometers). In contrast to the massive Cerros de Tancítaro, most of the volcanoes in the region are about the same size as Parícutin. The most distinctive features of Parícutin are its youth and well-known geological history. The series of biological events now in action there must have previously taken place in a similar fashion on all of the other volcanoes.

From the original vent in the cornfield at an elevation of about 2400 meters, the cinder cone of Parícutin grew to a height of 10 to 12 meters in one day. In six days it was 167 meters high with a basal diameter of 730 meters and a crater diameter of 90 meters. Within 25 days the cone was about 200 meters high, and nine months after birth its present dimensions had nearly been attained (Foshag and Gonzáles R., 1956). Subsequent growth was much slower because of the large area over which ejected material was spread, and

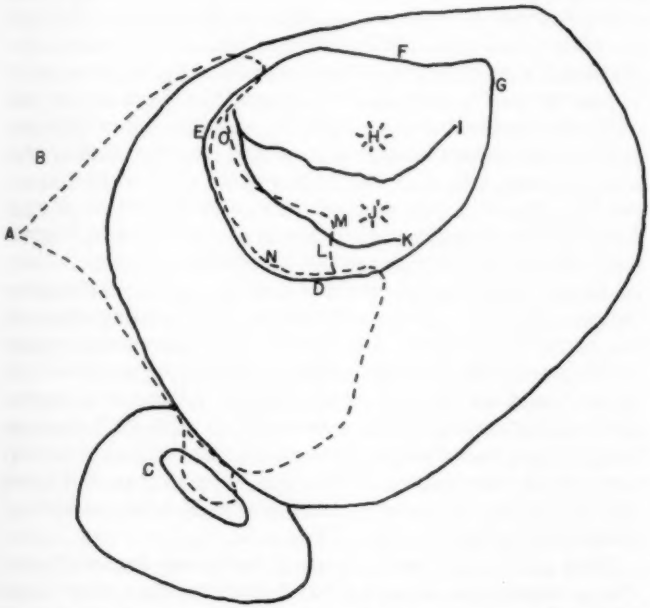

FIG. 1. Sketch of the cone of Parícutin Volcano looking southwesterly (modified from an oblique aerial photograph in Fries and Gutiérrez, 1954). A, route taken on cone; B, east base of cone; C, Nueva Juatita lava-vent mound; D, northeast saddle on rim of cone; E, east peak of rim; F, southwest saddle of rim; G, west peak of rim; H, southwest crater vent; I, ridge between crater vents; J, northeast crater vent; K, slump line; L, collection locality of *Pityrogramma calomelanos, P. tartarea, Pteridium aquilinum* var. *feei*, and undetermined fern; M, collection locality of *Pinus montezumae ?* ; N, collection locality of undetermined dicot seedling; O, collection locality of *Pellaea ternifolia* var. *ternifolia, Aegopogon cenchroides, Buddleia cordata, Aster exilis, Conyza coronopifolia, Eupatorium pazcuarense ?* , *Gnaphalium attenuatum*, and *G. semiamplexicaule.*

the increment from later ejecta was about balanced by erosion and slumping. Although the nearly final size of the cone was developed in a very short time, the exact morphology was not stabilized until activity ceased (Fries and Gutiérrez, 1954). Slumping of the sides occurred several times as a result of the flowing out of lava beneath. After slumps the cone sides were rebuilt by the ejection of pyroclastic material from the crater vents.

The dimensions of the cone on May 1, 1952 (three months after activity ceased) from measurements made by Fries and Gutiérrez (1954) are as follows: West peak, 2808.6 m. elevation; east peak, 2807.9 m. elevation; lowest point on the northeast rim, 2770.3 m. elevation; peaks of crater rim about 410 meters above original level of cornfield; base of cone oval with northeast-southwest diameter of about 650 meters and northwest-southeast diameter of 900 meters; crater rim nearly round with diameter of about 280 meters; bottoms of the two crater vents, aligned on northeast-southwest axis, about 30 or 40 meters below levels of northeast and southwest saddles on rim. The actual projection of the cone above its base is considerably greater than its apparent elevations because the lava flows immediately surrounding the cone are exceedingly thick. The Nueva Juatita lava-vent mound on the northeast side of the cone is only 79 meters below the lowest point on the rim of the crater. Although slumping, settling, and erosion have occurred since the 1952 measurements, the present dimensions of the cone probably are still very nearly equivalent. While the Volcano was still active the inclination of the outer slope of the cone ranged between 31° and 33° (Segerstrom, 1950).

Most of the cone is made up of successive layers of pyroclastic materials such as ash, cinders, lapillae, and bombs. Much of the upper crater surface is comprised of coarse to fine lapillae. The rim is mostly of fine cinders and ash with some larger fragments. The outer slope is of rather coarse rubble mixed with finer fragments. Segerstrom (1950) suggested that the base may contain some massive lava which does not extend very far up in the cone. According to Wilcox (1954) the petrographic character of the ejecta changed during the nine-year eruptive period from an olivine-bearing

basaltic andesite containing 55 percent silica to an orthopyroxene-bearing andesite containing over 60 percent silica. Williams (1950) indicated that the pyroclastic ejecta were identical with the lavas or differed only in having a higher glass content or a greater degree of vesicularity. At the end of activity in 1952, white crusts of ammonium chloride, deposited by exuding vapors, were conspicuous on the crater sides (Fries and Gutiérrez, 1954). Some of this material was still evident at the time of my visit in 1958, and gases were still being emitted by numerous fumerolic vents on both the cone and surrounding lava flows.

CLIMATE

The climate at Parícutin is temperate with a relatively cool, wet season from June to October and a cool, dry season from November to May. There are no climatic records for the area before the appearance of the Volcano, and the data are still inadequate. From rainfall records kept at two stations during most of the active period (cf. Fries and Gutiérrez, 1954) it can be seen that the annual precipitation varied from about 1300 to 2400 mm. Frosts and freezing temperatures occur during the winter months, but winter temperatures were reputedly milder during the eruptive period (Segerstrom, 1950).

PLANTS PREVIOUSLY REPORTED ON THE CONE

The first report of plants invading the cinder cone of Parícutin is by Eggler (1959) who indicated that in February of 1957 Mr. Kenneth Segerstrom of the U. S. Geological Survey found lichens and two species of angiosperms, probably a *Gnaphalium* and an *Eryngium*, growing on the rim of the crater. The *Gnaphalium* found by Segerstrom is very likely one of the two species of that genus obtained in the present study. Although no *Eryngium* was seen on the cone in this investigation, a specimen of *Eryngium beechyanum (Beaman 2399)* in full flower was found in volcanic ash at the edge of a deep gully about two kilometers east of the cone.

SPECIES FOUND IN 1958

The 14 vascular species found on the cone of Parícutin on September 1, 1958 are arranged by families below. Notes on habitats and certain other features of the plants are included. The route taken on the cone and the approximate

location of plants collected are shown in fig. 1. Voucher specimens are filed in the Herbarium of Michigan State University[1].

POLYPODIACEAE.

Pellaea ternifolia (Cav.) Link var. **ternifolia.** *(Beaman 2409).* Only two small plants, growing in volcanic ash kept moist by gases from a fumerolic vent, were found near the summit of the east rim of the crater. The smaller of the two specimens has numerous sporangia on the pinnae of some fronds.

Pityrogramma calomelanos (L.) Link. *(Beaman 2408C).* In the field this species was not distinguished from *P. tartarea,* and the two were inadvertently mixed in the collection. Either one or both species are common on the northeastern side of the crater among moderately coarse lapillae. These specimens are without sporangia.

Pityrogramma tartarea (Cav.) Maxon. *(Beaman 2408A).* See discussion under *P. calomelanos.* One plant of this collection, with a single frond, has young sporangia. Other specimens in the collection are sterile. A specimen of the same species obtained from the lava at the east base of the cone was much larger and had several well-developed fertile fronds. Both Eggler (1959) and Clausen (1959) have noted that this is a pioneer species on Parícutin lava flows.

Pteridium aquilinum (L.) Kuhn var. **feei** (Fee) Maxon. *(Beaman 2408B).* This species occurs with *Pityrogramma calomelanos* and *P. tartarea* on the sides of the crater. Two juvenile, sterile specimens were collected. Eggler (1948, 1959) and Clausen (1959) have noted that this is a common species in the Parícutin area.

Undetermined juvenile fern. *(Beaman 2408D).* The single sterile plant obtained, growing with *Pityrogramma calomelanos, P. tartarea,* and *Pteridium aquilinum* var. *feei,* is too immature to permit more than a guess as to its identity.

PINACEAE.

Pinus montezumae Lamb. ? *(Beaman 2410).* This seedling pine was growing about 10 meters below the northeast saddle

[1]I am indebted to Dr. Rolla Tryon for determinations of the ferns and to Dr. Rogers McVaugh for recognizing the sterile specimens of *Aster exilis,* and for suggestions that lead to the determination of another species. My able native guide for the trip to the cone was Sr. José Cruz Gomez of Angahuan, Michoacán. A grant from the Penrose Fund of the American Philosophical Society made possible the field study in Mexico.

on the side of the crater. Only a single specimen was found. The substrate was of rather coarse lapillae, and no fumerolic vents were noted in the near vicinity. *Pinus montezumae* is one of the most important forest components around Parícutin, and this plant is very similar to a mature specimen *(Beaman 2412)* collected near by. The only other common species of pine observed in the area is *P. leiophylla (Beaman 2422)*, and the seedling is definitely not that species. At least three other species *(P. pseudostrobus, P. michoacana,* and *P. teocote,* cf. Martinez, 1948) probably occur in the Parícutin region, but the seedling is more like *P. montezumae* than any of these. The specimen has secondary fascicles with only three and four needles (the species is typically five-needled), but variations above and below the usual number were found in other seedlings in the area. The plant was in at least its second season as indicated by the presence of both old, solitary primary leaves and younger secondary leaves.

GRAMINEAE.

Aegopogon cenchroides H. & B. *(Beaman 2411)*. Two small plants of this species, one with a slightly developed inflorescence, were found in volcanic ash kept moist by gases from a fumerolic vent near the summit of the east rim of the crater. A much more vigorous plant of the species *(Beaman 2390)*, already with several well-developed stolons, was found among lava boulders at the east base of the cone. This species was not observed in ash deposits that were examined several kilometers away from the cone, but the superficially similar species, *Cynodon dactylon,* was found to be an important pioneer in the ash.

LOGANIACEAE.

Buddleia cordata HBK. *(Beaman 2406)*. A single seedling plant was obtained near the summit of the east rim of the crater in volcanic ash kept moist by gases from a fumerolic vent. Several larger plants of the same species *(Beaman 2396)* were scattered on the lava at the east base of the cone. *Buddleia cordata* is a common species in the Mexican volcanic highlands.

COMPOSITAE.

Aster exilis Ell. *(Beaman 2405)*. This was the most abundant species in the moist volcanic ash by a fumerolic vent

near the summit of the east rim of the crater. None of the specimens had begun to flower, but other herbarium specimens of this common *Aster* closely match this collection.

Conyza coronopifolia HBK. *(Beaman 2407)*. Three small plants, two in flower, were found in the same area with *Aster exilis*. *Conyza coronopifolia* is a common weedy species in the Mexican volcanic highlands.

Eupatorium pazcuarense HBK. ? *(Beaman 2403)*. Five sterile plants of this species were found near the summit of the east rim of the crater in moist volcanic ash near a fumerolic vent. Several species of *Eupatorium* in this complex are very similar vegetatively, thus making determination difficult. A few larger plants *(Beaman 2393)* with dried flowering stems of the previous season still attached were found on moist lava cliffs at the east base of the cone. These closely resemble other herbarium specimens of *E. pazcuarense* from Michoacán.

Gnaphalium attenuatum DC. *(Beaman 2404)*. Four plants, one beginning to flower, were collected in the vicinity of a fumerolic vent near the eastern summit of the rim of the crater. Two specimens with abundant inflorescences *(Beaman 2394)* were found on lava at the east base of the cone.

Gnaphalium semiamplexicaule DC. *(Beaman 2412)*. Two specimens, one a rosette and the other at a slightly older stage, were obtained from the area near the summit of the east rim of the crater. Four other specimens *(Beaman 2392)* in bud and flower, were found on lava at the east base of the cone.

FAMILY UNDETERMINED.

Undetermined dicot seedling. *(Beaman 2402)*. This single plant was growing on the saddle of the northeast rim of the crater. No other plants were observed in the immediate area, but the pine seedling and the ferns (except *Pellaea ternifolia* var. *ternifolia)* were collected on the side of the crater not far below this point on the rim.

DISCUSSION

An extensive survey of the flora of the Parícutin region has not been published, but a floristic study of the south side

of the neighboring Cerros de Tancítaro was made by Leavenworth (1946). At comparable elevations many species are common to these two areas, but only six of the 14 species found on the cone of Parícutin were also collected by Leavenworth. Observations on the vegetation in the vicinity of Parícutin were made by Eggler (1948, 1959) and Clausen (1959), but their interests were not primarily floristic. Only two of the species *(Pityrogramma tartarea* and *Pteridium aquilinum)* which Eggler (1959) noted for their ability to survive or reproduce in the volcanically affected soils were found on the cone in this study. I made some effort to locate in near by areas the same species that were collected on the cinder cone. This attempt was most successful on the lava flows adjacent to the cone where six of the same species were found. A thorough study of the flora of the Parícutin region is still needed to give some measure of the overall importance of species as they colonize the barren volcanic deposits.

It seems highly probable that all of the species on the cone were carried there as wind-borne propagules, although dispersal by animals, especially birds, cannot be entirely discounted. The Polypodiaceae and the Compositae, both with five species, are predominant in the cone flora, while the other three determined species belong to different families. The small size of the fern spores makes them well adapted to wind transport. All of the Compositae found on the cone are species with a well-developed pappus. The winged seeds of the pine make wind dispersal also the likely method of its transport. *Aegopogon cenchroides* has small, light spikelets with several awns which would serve in wind dispersal about as effectively as the pappus of the composites. The *Buddleia* species has very small seeds which could be blown by wind for a considerable distance.

Soil conditions, in contrast to those in which the species ordinarily occur, must be extremely inorganic on the cone. Organic products would be present only through the biological actions of the earliest pioneer species or by being transported there from surrounding areas. These sources must have already contributed some organic materials, but the

cone substrates probably have not yet been significantly altered. In the studies of Katmai Volcano in Alaska, Griggs (1919) noted that a scarcity of organic nitrogen retarded revegetation more than any other factor. Eggler (1959) suggested that ammonium chloride deposits, which are abundant on the cone of Parícutin, may provide a nitrogen source for plants.

Substrates on the cone in which plants were growing can be roughly classified into three types: Moist ash near fumarolic vents, relatively coarse lapillae on the crater sides, and ash on the crater rim away from fumerolic vents. Eight species were found by the fumerolic vents, five in the lapillae on the side of the crater, and only one, a small seedling, in ash away from fumerolic vents on the rim of the crater. No plants were found on the outer slopes of the cone, possibly because the rubble is coarser and less stable, and there is a lack of fumerolic vents. The concentrations of plants in wet habitats on both the cinder cone and on surrounding lava flows suggest that water is an especially important factor in enabling species to become established. A thorough assessment is needed of the role of non-vascular species in modifying habitats on the volcanic materials.

The success in establishment of species on the cone should be reflected, to a certain extent, in their maturity and vigor. A rather long period would have been necessary for the two woody species, *Pinus montezumae* ? and *Buddleia cordata*, to attain a reproductive age. Three herbaceous angiosperm species, *Aegopogon cenchroides*, *Conyza coronopifolia*, and *Gnaphalium attenuatum*, had flowered; and two ferns, *Pellaea ternifolia* var. *ternifolia* and *Pityrogramma tartarea*, had produced sporangia. The other species were still only in a vegetative state. All of the fern species had a distinctly juvenile appearance. Although none of the plants were especially robust, the fact that five species had reached reproductive maturity is noteworthy.

Most of the species observed on the lava at the eastern base of the cone were more vigorous than those on the cone, yet that lava could hardly have been colonized by plants any earlier than the cone itself. Part of this area received one of the last flows to be emitted from the Volcano in 1952

(Fries and Gutiérrez, 1954). *Eupatorium pazcuarense* ? on the lava had flowered in the previous season, and both species of *Gnaphalium* and the *Buddleia* were exhibiting vigorous growth. Several healthy specimens of *Calamagrostis pringlei (Beaman 2389,* not present on the cone) were also well established. In the lava there are numerous basins, protected crevices, and caves to collect ash, silt, and water which produce conditions favorable for plant growth. Likewise, greater protection against extremes of evaporation and erosion is afforded by the lava. Clausen (1959) reported finding eight species of ferns, two mosses, and two Gnaphaliums on lava (deposited 11 years before his visit) near San Juan Parangaricutiro. Eggler (1959) indicated that in 1950 he found a blue-green alga and mosses growing on flows after three years, and after four years three species of ferns were established.

The brief period between the cessation of activity by the Volcano and the discovery of plants on its cinder cone demonstrates that only a short time is necessary for the initiation of primary succession. Parícutin now provides a model design for the study of plant dispersal, establishment, succession, and community development on inorganic volcanic products. — DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, MICHIGAN STATE UNIVERSITY, EAST LANSING.

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CONTRIBUTION TO THE FUNGUS FLORA OF NORTHEASTERN NORTH AMERICA[1]

HOWARD E. BIGELOW AND MARGARET E. BARR[2]

In the following account, seven species of agarics are discussed by the senior author. *Hygrophorus purpureofolius* is described as a new species, and the new combinations *Clitocybe hudsonianus* (Jenn.) Bigelow and *Lyophyllum multiforme* (Pk.) Bigelow are proposed. Information on the three pyrenomycetes has been prepared by the junior author, and the new combinations *Anisostomula rubescens* (Ell. & Everh.) Barr and *Gnomonia acerophila* (Dearn. & House) Barr are proposed.

Acknowledgment is made to the Faculty Research Council, University of Massachusetts, for financial support of our field program during 1958 and 1959. We also wish to express our appreciation to the following for the privilege of examining type material: Dr. L. R. Hesler, Department of Botany, University of Tennessee; Dr. Clark T. Rogerson, Curator, Cryptogamic Herbarium, New York Botanical Garden; Dr. A. H. Smith, Director, Herbarium, University of Michigan; Mr. Stanley J. Smith, Senior Curator of Botany, New York State Herbarium.

Colors cited in the descriptions of agarics, except in the case of *Clitocybe hudsonianus*, are from Ridgway, R. 1912. Color standards and color nomenclature, Washington, D. C. The colors given for *Clitocybe hudsonianus* are from Villalobos-Dominguez, C. and J. Villalobos. 1947. Atlas De Los Colores, Buenos Aires.

[1]Contribution from the Department of Botany, University of Massachusetts, Amherst.
[2]Mrs. Howard E. Bigelow.

Clitocybe compressipes (Pk.) Saccardo, Syll. Fung. 5: 184. 1887

Agaricus compressipes Peck, N. Y. State Mus. Rep't 33: 18. 1880.
Omphalia graveolens Petersen, Danske Agaricaceer, p. 137. 1907.
Clitocybe farinacea Murrill, N. Amer. Fl. 9: 401. 1916.

Pileus 1-3 cm. broad, convex at first with margin narrowly incurved and inrolled, disc slightly depressed at times, expanding to convex or plane, disc usually depressed, margin even, surface with thin hoary coating, becoming appressed, ground color a watery buff to brownish ("vinaceous buff", "pinkish buff", "cinnamon buff"), hygrophanous, soon fading to whitish or pale buff ("light buff", "pale ochraceous buff", "pale pinkish buff"); flesh concolorous with the pileus, thin, cartilaginous-brittle, odor and taste farinaceous.

Lamellae short decurrent to moderately decurrent, close and moderately broad in expanded specimens, sometimes narrow and subdistant when young, rarely forked, not intervenose, whitish.

Stipe 1.5-3.5 cm. long, 1-6 mm. thick at the apex, equal or either end enlarged, base usually with slight whitish tomentum, at times with a few slender rhizoids, solid, rarely eccentric, often curved, compressed at times, surface with whitish fibrillose coating, thin and soon appressed except at apex, ground color near that of moist pileus, not fading.

Spores (5-)5.5-8 x (2.5-)3-5 μ (up to 11 μ long from 2-spored basidia), elliptical or ovate, smooth, amyloid, white in mass; basidia 25-32 x 5.5-8 μ, usually 4-spored, occasionally 2-spored; filamentous cheilocystidia present, distribution variable, abundant on some lamellae, sparse or absent on others, protruding 23-62 μ beyond the edge of lamellae, 1-3 μ in diameter, smooth, hyaline; pileus tissue: surface somewhat gelatinous in KOH but not a true pellicle, cuticular hyphae cylindrical, 2.5-4 μ in diameter, sometimes with dilute yellowish or brownish intracellular pigment in KOH, trama hyaline, hyphae usually somewhat inflated, 6-16 μ in diameter, clamp connections present; gill trama regular.

Scattered to gregarious, rarely subcespitose or solitary. In the open in grass, in soil under hemlock or pine, on sandy road shoulder in mixed woods. July to October.

Material examined: *Bigelow 6841*, Amherst, Mass., July 12, 1958; *6908*, Hatfield, Mass., July 16, 1958; *6947*, Hawley, Mass., July 17, 1958; *7502*, Leverett, Mass., Aug. 14, 1958; *7632*, N. Amherst, Mass., Aug. 27, 1958; *7730*, same locality, Sept. 14, 1958; *7800*, same locality, Sept. 20, 1958; *8745*, Leverett, Mass., Oct. 13, 1959; *C. H. Peck*, Albany, N. Y., July (type of *C. compressipes*).

Clitocybe compressipes is one of the group of species having smooth amyloid spores, clamp connections, and filamentous cheilocystidia, which Singer (1951) includes in the genus *Cantharellula*. *C. felleoides* Kauffman, *C. intermedia* Kauffman, *C. farinacea* Murrill, *Omphalia kalchbrenneri*

Bresadola, and *Omphalia graveolens* Petersen must be considered in a discussion of the relationships of *C. compressipes.*

There is no difficulty in separating *C. compressipes* and *C. felleoides.* The lamellae of *C. compressipes* are close and whitish, whereas in *C. felleoides* they are distant and yellowish.

Clitocybe intermedia I know only from my examination of the type collection and Kauffman's (1927) original description. The distinguishing characters from *C. compressipes* are: pileus "orange cinnamon", lamellae narrow and often yellowish, stipe hollow.

As described and illustrated by Bresadola (1883, 1928), *Omphalia kalchbrenneri* is also distinct from *C. compressipes.* The striate pileus, distant and long decurrent lamellae, absence of farinaceous odor and taste, long spores (8-10 μ), are all features which are different from *C. compressipes.*

Clitocybe farinacea Murrill is here placed in synonymy with *C. compressipes* for my study of the type specimens of both species has not revealed any critical differences. Singer (1951) regards *C. farinacea* as a synonym of *O. kalchbrenneri,* but I do not believe this disposition is tenable. The strong farinaceous odor and taste of *C. farinacea* and spores 6-8 μ long are features of *C. compressipes* not *O. kalchbrenneri.* Singer (1951) also has placed *Omphalia graveolens* Petersen in synonymy with *O. kalchbrenneri.* However, Peterson (1907) emphasizes a distinct farinaceous odor for *O. graveolens* and spores 7-8 μ long, again features of *C. compressipes* rather than *O. kalchbrenneri.* Kühner's (1954) interpretation of *O. graveolens* is much broader than the original and seems to encompass not only *C. compressipes* and *O. kalchbrenneri* but also *C. felleoides.*

C. compressipes f. *autumnale* Kauffman has nonamyloid spores, 4-5 $\times$ 2.5-3 μ, and is not related to *C. compressipes.* It seems likely that *C. compressipes* f. *autumnale* is within the range of *C. regularis* Peck or *C. angustissima* (Lasch) Kummer.

Clitocybe highlandensis Hesler and Smith, Lloydia 6: 254. 1943

As far as known, this is the first report of this *Clitocybe*

outside of North Carolina and Tennessee. The two collections from Massachusetts cited below have been compared with the type collection and found to be identical with it in all respects.

C. highlandensis belongs to the section *Disciformes* and probably should be placed near *C. harperi* Murrill because of the general aspect and the absence of clamp connections. The spores of *C. highlandensis* appear very slightly granose-roughened under an oil immersion lens, but the lack of clamp connections and a white spore deposit prevent the inclusion of this species in the genus *Lepista.*

Material examined: *Bigelow 8406,* Leverett, Mass., Aug. 11, 1959; *8554,* New Salem, Mass., Sept. 2, 1959; *Hesler and Smith 7537* (type), Highlands, N. C., Sept. 10, 1937.

Clitocybe hudsonianus (Jenn.) Bigelow, comb. nov.

Hygrophorus hudsonianus Jennings, Mem. Carnegie Mus. pt. III (Botany), 12: 2. 1936.

Pileus 8-23 mm. broad, convex at first, disc soon becoming shallowly depressed, margin crenate and faintly pellucid-striate at times, expanding to broadly convex, finally plane or rarely broadly infundibuliform, surface glabrous or with white pubescence about the disc, somewhat waxy-appearing at times, hygrophanous, color bright orange-yellow when moist (O 18-12°, OOY 18-12°) fading very slowly to whitish (O 19-6°); flesh thin, rather brittle and cartilaginous, concolorous with surface of pileus and fading in a similar manner, odor and taste not distinctive.

Lamellae adnate at first, soon becoming short decurrent, finally moderately decurrent, subdistant, broad (3-4 mm.), waxy-appearing, near concolorous with the moist pileus but not fading, edges even.

Stipe 1.5-2 cm. long, 1.5-3 mm. broad, usually equal, base with a small amount of white tomentum, fistulose, often curved, surface white-pubescent, pallid or pale orange-yellow (OOY 18-6°, O 19-6°) beneath the pubescence.

Spores 6-8(-9) x 4-5.5(-6) μ, usually elliptical or obovate, rarely oblong or subglobose, smooth, not amyloid, pale orange-yellow in mass (nearest OOY 19-12°); basidia 29-52 x 5.5-7(-8) μ, usually 4-spored, rarely 2-spored, sterigmata 5-6.5 μ long; cystidia: caulocystidia present, 60-130 μ long, 5-8 μ in diameter, hyaline, walls thin and smooth; pileus tissue: ± homogeneous, hyphae usually cylindrical, 2-8 μ in diameter, hyaline in KOH, clamp connections absent; gill trama interwoven, hyphae cylindrical, 2-5 μ in diameter.

Gregarious to subcespitose, on tundra. July and August.

Material examined: Mt. Albert, Gaspé Parc, Quebec, *Bigelow 5306, 5307, 5308, 5310, 5311, 5312, 5313, 5314, 6180;* Whiteface Mt., New York, *S. J. Smith.*

This species fruited abundantly on top of Mt. Albert in July and August of 1957. Frequently, the carpophores were growing near or intermixed with *Clitocybe umbellifera* (Fr.) Bigelow. The two species were the most abundant agarics to be found on this mountain top. Both are typical of a more northern flora, as is the other vegetation in this locality.

Emphasis has been placed upon the colored spore deposit of *C. hudsonianus* in making the transfer from *Hygrophorus*. Such a character is not uncommon in *Clitocybe*, but is decidedly atypical of *Hygrophorus*. Although the waxy-appearing lamellae of *C. hudsonianus* may indicate some intermediate relationship with *Hygrophorus*, it appears to be most closely related to such clampless species as *C. umbellifera* (Fr.) Bigelow and *C. luteovitellina* (Pilat and Nannfeldt) Bigelow.

Except for the waxy nature of the lamellae, *Clitocybe hudsonianus* is identical in appearance with *C. luteovitellina* (Pilat and Nannf.) Bigelow. They are also identical in microscopic characteristics except for spore shape and width. Those of *C. hudsonianus* are variable in shape and 4-5.5(-6) μ broad. *C. luteovitellina* has elliptic-oblong spores which are variously reported as: 3-4 μ broad (Moller, 1945, as *Omphalia flava)*, (Pilat and Nannfeldt, 1954, as *Omphalia luteovitellina);* 3.5-4.3 μ (Favre, 1955, as *Omphalia flava);* 4-4.9 μ (M. Lange, 1955 as *Omphalina flava);* 4-5 μ (Bigelow, 1959). The similarity of these two species requires a critical observation in the field on the texture of the lamellae of *C. luteovitellina* and further study on spore variation.

Clitocybe umbonata (Fr.) Konrad, Bull. Soc. Myc. Fr. 47: 146. 1931

A pure white form of this common agaric was found Oct. 13, 1959 in Leverett, Mass. (Bigelow 8740). About twenty-five carpophores were found growing in a gregarious fashion on Polytrichum in an abandoned pasture. The typical form with grayish pilei was found in other groups a few yards distant. Except for the absence of pigment, the albino form had all the characteristics of *C. umbonata.*

Hygrophorus purpureofolius Bigelow, sp. nov. Plate 1253

Pileus 1-5 cm. latus, convexus demum planus, haud pellucidus, glaber,

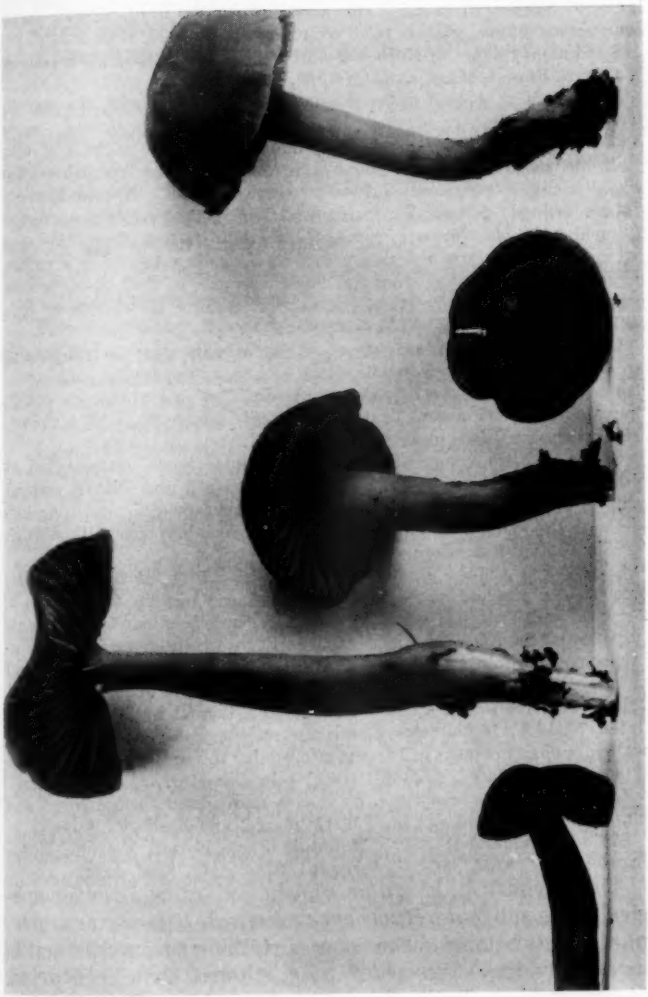


PLATE 1253. *Hygrophorus purpureofolius* sp. nov. × 1½.

primum rubro-aurantiacus, tum aurantiacus, hygrophanus, demum flavus; lamellae adnatae vel decurrentes, confertae vel subdistantes, latae, violaceae; stipes 2.5-7 cm. longus, apice 4-9 mm. crassus, saepe compressus, cavus, glaber, pileo concolor; sporae 7-11 x 4-5.5 μ.

Specimen typicum in Herb Univ. of Mass. conservatum; legit Savoy Mt. State Forest, Mass., Aug. 7, 1959, *Bigelow 8363*.

Pileus 1-5 cm. broad, conic or campanulate at first with the margin incurved and slightly inrolled, soon convex or broadly convex, finally plane and margin often somewhat undulate, surface opaque and dull, glabrous, not viscid, moist and hygrophanous, a dark reddish-orange when young ("vinaceous rufous", "Hays russet", "Kaiser brown", "Mars orange"), becoming paler and more orange when expanded ("burnt sienna", "orange rufous"), usually fading from the disc outward, radiate-streaked or squamulose in fading, becoming a rather bright yellowish-orange (nearest "deep chrome"); flesh thin, brittle, concolorous with the moist pileus at first, fading to whitish or pale yellowish, odor and taste not distinctive.

Lamellae broadly adnate to short decurrent, close to subdistant, broad (2-6 mm.), rather brittle, thick and waxy-appearing, dull lavender to purplish (nearest "pale purple drab", "pale vinaceous drab", "purple drab", "vinaceous drab", "deep dull lavender"), with a yellowish cast in age, edges even.

Stipe 2.5-7 cm. long, 4-9 mm. thick at apex, equal or enlarged at either end, ventricose at times, often compressed and with a vertical groove, usually curved or flexuous, hollow, surface glabrous, concolorous with the moist pileus and not fading appreciably, base with whitish or lilac-colored tomentum.

Spores 7-11 x 4-5.5 μ, elliptical to elliptic-oblong, at times obovate, smooth, not amyloid, spore print not obtained; basidia 42-55 x 6-8 μ, 2-spored and 4-spored; cystidia not differentiated; pileus tissue: faintly yellowish in KOH, pigment apparently intercellular and intracellular, somewhat soluble in water and KOH, cuticular hyphae cylindrical or slightly inflated, 2.5-7.5 μ in diameter, end cells often protruding, subclavate or clavate, < 10 μ in diameter, tramal hyphae mostly inflated, 7.5-14.5 μ in diameter, clamp connections present, scattered thick-walled hyphae present; gill trama subregular to regular, hyphae usually somewhat inflated, (2.5-)6-10(-12) μ in diameter.

Gregarious to subcespitose, on leaves and humus, under birch and maple, or in a mixed woods of birth, maple, and hemlock. August.

Material examined: Savoy Mountain State Forest, Florida, Mass., *Bigelow 8361, 8362, 8363* (type), *8364, 8365, 8421, 8422, 8423*.

The purplish gills are an unusual characteristic for species in the subgenus *Hygrocybe*, to which *Hygrophorus purpureofolius* belongs. The color is striking in the field and is usually evident even after the specimens have been dried. *H. mephiticus* Peck, described from Massachusetts, has violaceous gills, but is distinctive by the yellow-brown pileus

and stipe and a mephitic odor. *H. troyanus* Murrill, described from Jamaica, also has similarly-colored gills but is a small viscid species.

Hygrophorus tennesseensis Smith and Hesler, Lloydia 2: 40. 1939

Four collections of this species were found during the fall of 1959. All were found growing in a gregarious fashion on needles under white pine. The characteristics of the carpophore checked with those of the published description by Smith and Hesler (1939). Dr. L. R. Hesler of the University of Tennessee has kindly compared some of the dried specimens with the type collection, and found complete agreement on all observable features.

The following records apparently represent the most northern occurrence of this species so far to be noted.

Material examined: *Bigelow 8616*, Chesterfield, Mass., Sept. 8, 1959; *8640*, Conway, Mass., Sept. 13, 1959; *8387*, Leverett, Mass., Oct. 4, 1959; *8731*, Shutesbury, Mass., Oct. 10, 1959.

Lyophyllum multiforme (Peck) Bigelow, comb. nov.

Clitocybe multiformis Peck, N. Y. State Mus. Mem. 4: 141. 1900.

Pileus 2-7 cm. broad, convex at first, expanding to broadly convex or plane, broadly subumbonate at times, glabrous, dull, watery whitish with a creamy to pale yellowish tint when moist (nearest "cream buff"), margin finely pellucid-striate in expanded specimens, hygrophanous, fading to white and opaque, edge becoming brown at times; flesh moderately thick on the disc, thin on the margin, watery and concolorous with the moist pileus, fading to whitish, brittle, no odor, taste slightly acidulous.

Lamellae adnexed to adnate or short decurrent, evenly and forming a collar on the stipe apex, close, narrow, whitish (nearest "cream buff"), edges even.

Stipe 3.5-8.5 cm. long, 5-13 mm. thick at the apex, base often curved and strigose, hollow at times and compressed, surface innately fibrillose-striate, often silky and shining, white.

Spores 5.5-7.5 x 2.5-3.5(-4) μ, elliptical or rarely elliptic-oblong, smooth, not amyloid, white in mass; basidia 23-35 x 3-7 μ, usually 4-spored, occasionally 2-spored, aceto-carmine granules present; cystidia not differentiated; pileus tissue: surface somewhat gelatinous in KOH, cuticular hyphae cylindrical, 1.5-3.5 μ in diameter, tramal hyphae cylindrical to inflated, 3.5-11 μ in diameter, clamp connections present; gill trama subregular, hyphae usually cylindrical, 3.5-8 μ in diameter.

Gregarious to cespitose, on wood debris, under hardwoods, September and October.

Material examined: Sunderland, Mass., *Bigelow 7782, 7853, 7914; C. H. Peck*, Meadowdale, Albany Co., N. Y., October (type).

The pallid pileus and elliptical spores distinguish *Lyophyllum multiforme* from all species of the section *Difformia* but *L. connatum* (Fr.) Singer. In a comparison with the latter, *L. multiforme* is distinct by the hygrophanous, striate pileus and absence of an odor. *L. connatum* is shining white and with a farinaceous odor.

Anisostomula rubescens (Ell. & Ev.) Barr, comb. nov.
Figs. 4, 5

Laestadia rubescens Ellis and Everhart, North American Pyrenomycetes, p. 259. 1892.

Perithecia 100-200 μ in diameter, 80-150 μ high, depressed-globose, collapsing when dry, immersed, loosely grouped as brown dots on yellowish irregular areas of the upper leaf surface, rarely hypophyllous, wall 15-18 μ wide at sides and base, of several layers of compressed yellowish cells, at the apex dark brown or reddish brown, thickened and forming a slight clypeus by radiating dark hyphae, pore variable, 18-40 μ wide, periphysate, with light brown hyphae in leaf tissues.

Asci 45-54 x 5.5-10 μ, oblong to broadly cylindrical, apex rounded or truncate, short stalked, wall single, thin and delicate, thickened at the apex, with refractive points of projecting cytoplasm, in iodine the pore outlined in bright blue, as two globules in side view, paraphyses few, delicate, 2-3 μ wide, septate, guttulate.

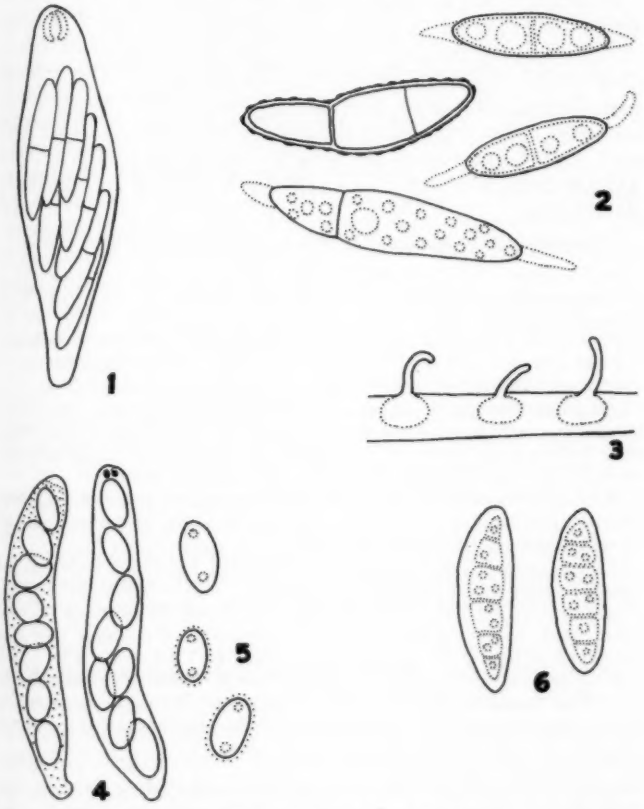
Spores 6.5-10 x 4.5-5 μ, hyaline, ovoid to ellipsoid, ends rounded to obtusely pointed, straight to inequilateral, 1-celled, wall double, smooth, often surrounded by a guttulate sheath when emerging from the ascus, contents refractive, with two globules, one near each end, obliquely uniseriate or partially overlapping biseriate in the ascus.

On overwintered leaves of *Castanea dentata*, still hanging from the branch.

Material examined: Mt. Grace State Forest, Warwick, Mass., July 28, 1959, *Barr 2609; J. B. Ellis*, Newfield, N. J., April 4, 1891 (type of *Laestadia rubescens*).

According to von Arx and Müller (1954), the genus *Anisostomula* includes four species, all occurring on leaves of species of *Quercus* in various regions of Europe. Both the type material of *Laestadia rubescens* and my own collection agree in all respects with the generic diagnosis. Of the previously described species of *Anisostomula*, *A. rubescens* appears to be most closely related to *A. areola* (Fckl.) von Höhnel. *A. areola* has a similar perithecial wall, thin and light colored at the sides and darkened and clypeal around the pore. However, the spores in *A. areola* are narrower (3-4 μ wide) and are arranged biseriately in the ascus.

A search of the literature produced the descriptions of three species of "Laestadia" on leaves of *Castanea*, all of which bore some resemblance to my fungus. The type specimens of *Laestadia orientalis* Ellis and Everhart (Proc. Acad. Nat. Sci. Phila. 1890: 230. 1891) and *L. castanicola* Ellis and Everhart (North American Pyrenomycetes, p. 259.



FIGS. 1-3. *Gnomonia acerophila:* 1, ascus showing refractive apex, 2, ascospores, 3, habit of perithecia in petiole. FIGS. 4, 5. *Anisostomula rubescens:* 4, two asci, that on the right in iodine to show blue-staining apical pore, 5, ascospores. FIG. 6. *Trichometasphaeria gloeospora*, two ascospores from type material of *Leptosphaeria asparagi*. Figs. 1, 2, 4, 5, 6 × 1500; fig. 3 × ca. 20.

1892), proved to be identical. Both have a diaporthaceous structure, no beak or a very short broad one, and one-celled spores. These two collections are identical with European and North American specimens of *Sphaerognomonia carpinea* (Fr.) Potebnia on *Carpinus*. The names *L. orientalis* and *L. castanicola* are to be regarded as synonymous with *S. carpinea*. Incidentally, Miller and Thompson (1940) have already reported *S. carpinea* on leaves of a number of deciduous trees in Georgia. I have also found this species on leaves of *Quercus rubra* var. *borealis* in Massachusetts (Barr 2552 and 2560). The type specimen of *Laestadia rubescens* is identical with the material from Massachusetts. The asci and spores are somewhat larger than Ellis and Everhart (1892) gave (asci 40 × 6 μ, spores 5-6 × 3.5-4 μ) in their description.

Gnomonia acerophila (Dearness and House) Barr, comb. nov. Figs. 1-3

Gnomoniopsis acerophila Dearness and House, N. Y. State Mus. Bull. **233-234**: 36. 1921.

Perithecia 420-600 μ in diameter, 350-400 μ high, immersed, depressed-globose, scattered to grouped, beaks erumpent, 300-1000 μ long (rarely up to 2 mm. long), 100-130 μ wide near base, narrowed to 60-70 μ wide near apex, central to somewhat lateral, curved, somewhat irregular, wall blackened, hyaline near apex, periphysate, perithecial wall 20-33 μ wide, of one to two layers of dark brown, large cells externally, and inner layers of compressed hyaline cells.

Asci 50-87 x 12-16.5 μ, ellipsoid, narrowed to the rounded apex and short-stalked base, wall delicate, with two elongate refractive areas at apex, no blue in iodine, aparaphysate.

Spores 16.5-33 x 4-6.5 μ, greenish hyaline, becoming yellowish in age, at times dull brown, cylindric-fusoid, ends rounded to pointed, straight to slightly curved, 1-septate in the middle or below it, not constricted, in age a second septum formed in the upper cell, appendaged at both ends, appendages hyaline, (2-) 5-9 (-11) μ long, 1-2 μ wide, truncate or pointed, straight or curved, wall double, smooth but in iodine becoming slightly roughened or irregular, in overmature brown spores roughened with brown granules, contents with two large globules in each cell, in a fascicle in the ascus.

On petioles, overwintered, of *Acer* spp.

Material examined: *Acer pennsylvanicum*, Oneida, N. Y., May 15, 1918 (type of *Gnomoniopsis acerophila); Acer rubrum*, Huntington Forest, N. Y., June 29, 1957, *Barr 1888A; Acer* sp., Ste. Adele, Quebec, June 22, 1957, *Barr 1864; Ellis and Everhart*, North American Fungi *2139* (as *Gnomonia emarginata* Fckl.), Newfield, N. J., June, 1888.

The genus *Gnomoniopsis* (Wint.) Berlese was erected to

accommodate species of *Gnomonia* in which the spores developed more than one septum. This distinction is not sufficient to maintain a separate genus, and von Arx (1951) considers that *Gnomoniopsis* and *Gnomonia* are the same. Dearness and House (1921) described the spores of *Gnomoniopsis acerophila* as one to five septate, but the type material contains spores with one primary septum, and rarely a secondary very thin septum in the upper cell. According to the collections examined, *G. acerophila* is most closely related to *G. campylostyla* Auerwald, on leaves of *Betula*. Both species have the beak frequently crooked and irregular, varying in position from central to lateral. In both the asci are large with elongate refractive areas at the apex. The spores of *G. campylostyla*, from material which I have collected, measure 18-25.5 × 3 μ, rarely show faint appendages at the tips, and at times have two additional septa. *G. acerophila* may be separated from *G. campylostyla* by its habit on petioles, rarely extending a short distance up the midvein, its longer, stouter beak, and the broader spores with distinct appendages.

The specimens issued by Ellis and Everhart in North American Fungi 2139 as *Gnomonia emarginata* Fuckel agree in all respects with my material of *G. acerophila*. According to the literature, *G. emarginata* is confined to petioles of *Betula* spp., and has curved, one-celled, biguttulate spores, narrower than those of *G. acerophila*.

Gnomonia acerophila differs from the other species of *Gnomonia* reported on *Acer* in larger sizes throughout, in its long, bent beaks, and in being confined to petioles of the leaves.

Trichometasphaeria gloeospora (Berk. and Curr.) Holm, Symb. Bot. Upsalienses 14(3): 144. 1957. Fig. 6

Holm (1957) has given a detailed description and synonymy of this fungus. To the synonymy of *T. gloeospora* should be added *Leptosphaeria asparagi* Peck (N. Y. St. Mus. Rep't 40: 70. 1887). Ellis and Everhart (1892) have previously included Peck's species as the same as *Leptosphaeria comatella* (Cke. and Ell.) Saccardo. The latter is identical with *T. gloeospora*, as Holm has observed. I have studied type material of Peck's *L. asparagi*. It agrees in all

respects with Holm's description of *T. gloeospora* and with specimens of *Sphaeria comatella* issued by Ellis. The Massachusetts material of *T. gloeospora* is similar to the other material examined and to Holm's description.

Material examined: on *Asparagus* stalks, North Amherst, Mass., June 3, 1959, *Barr 2556; Ellis* North American Fungi *190* and *190d*, Newfield, N. J. (as *Sphaeria comatella* Cke. and Ell.); Fungi Columbiana 1425a and 1425b, Newfield, N. J., (as *Leptosphaeria comatella* (Cke. and Ell.) Sacc.); on *Asparagus*, Menands, N. Y., Oct.. 1886, *C. H. Peck* (type of *Leptosphaeria asparagi).*

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ELYMUS ARENARIUS AND DIARRHENA AMERICANA IN WISCONSIN

HUGH H. ILTIS, JACK REED, AND THOMAS MELCHERT

There are few families that have been as thoroughly collected and worked on for the Flora of Wisconsin as the Gramineae. A book on the Grasses of Wisconsin (Fassett 1950) has been published which in turn is partially based on an unpublished Ph.D. thesis dealing with the Gramineae of the state (Shinners, 1943). It is therefore an uncommon event when a grass new to the state is discovered, or when substantial range extensions are recorded.

ELYMUS: The second author, under a research participation program supported by the National Science Foundation, has been engaged in a thorough floristic survey of the Point Beach State Forest, 4 miles north of Two Rivers, Manitowoc County, Wisconsin. Located on the shores of Lake Michigan, its diverse habitats, especially the beautiful dunes and swales, have long attracted botanical collectors. One of the 30 Wisconsin *Scientific Areas* is located in the forest.

Among the collections made last summer there was a well-developed specimen of **Elymus arenarius** L., the first record for this northern European strand species from Wisconsin. Swezey (1883) listed for Wisconsin the closely related *Elymus mollis* Trin. without precise locality, and no voucher specimens are known to back his report. It is possible that this is based on a collection of *Elymus arenarius*. *Elymus mollis*, a native North American species, does not occur in Wisconsin, its closest stations being on Lake Superior in Upper Michigan[1].

The specimen (Reed 381-WIS) grew on shifting sands of the first ridge of dunes paralleling the Lake Michigan strand, between, and south of, the main lodge and the lighthouse (T-20-N; R-25-E; Sect. 9). Its associated grass species, all very characteristic of the dunes, included *Ammophila breviligulata*, *Calamovilfa longifolia* var. *magna*, the endemic, as yet unnamed Great Lakes ecotype of *Agropyron dasystachyum*, as well as *Agropyron trachycaulon*, *A. repens*, *Elymus ca-*

[1]We are grateful to our "rival" floristic worker, Dr. Ed Voss of the University of Michigan, Ann Arbor, for calling our attention to Dr. Bowden's paper, and for this distributional information.

nadensis and *Koeleria cristata*. The specimen was in full fruit when collected on July 9.

The taxonomic confusion surrounding *Elymus mollis* and *E. arenarius* has been carefully and thoroughly elucidated by Bowden (1957). All Illinois collections of *E. mollis* cited by Jones (1955), who followed Hitchcock and Chase (1950), are *E. arenarius*. To these two Illinois collections, both from Cook County, we may add the following, based on a specimen deposited at WIS: Lake County: Lake Forest, Dec. 8, 1918, *L. S. Cheney s.n.*

Diarrhena americana: Fassett (1950) cites only one sheet of this species, since identified as var. *obovata* Gleason by Dr. Dennis Anderson, from Fayette, Lafayette County, Wisconsin, 1894, with no exact location data given. Attempts by the senior author to relocate this stand were unsuccessful. During the last two years, this taxon was rediscovered in Wisconsin at two localities. A large clone some 10 feet in diameter was found by the senior author in a very fine floodplain forest, the so-called "Avon Bottoms", along the Sugar River, 2 mi. SE of Avon (SW of the new bridge), in southwesternmost Rock county. Here, in association with *Quercus bicolor* (14'7" Diam. at breast heighth, the largest in Wisconsin!), *Q. macrocarpa, Ulmus americana, Acer saccharinum, Celtis occidentalis* and *Tilia americana,* grow a wealth of species, including some southern ones otherwise rare in most of Wisconsin, such as *Platanus occidentalis, Arabis shortii, Arisaema dracontium, Cephalanthus occidentalis, Chaerophyllum procumbens* — an abundant annual Umbelliferae here at its only Wisconsin station, *Evonymus atropurpureus,* and *Menispermum canadense.*

The third author found fully mature specimens of *Diarrhena* in a deciduous open forest along the Kickapoo River below Wisconsin Highway 131, in southern Monroe County (T-15N; R-2W; Sect. 13), a station some 100 miles to the north of the nearest previous one. The grass may actually be more common in Wisconsin, but perhaps is collected rarely since it fruits in late summer, a time when, in the past at least, collecting activity at Wisconsin was at a minimum.

The field trips of the first and third authors have been supported by the Research Committee of the Graduate School of the University of Wisconsin from funds supplied by the

Wisconsin Alumni Research Foundation. — DEPARTMENT OF BOTANY, UNIVERSITY OF WISCONSIN, MADISON

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HERBARIUM TECHNIQUES. — 1. *A Quick Method for Preparing Permanent Mounts of Seeds or Small Fruits.* — The cardboard micropaleontological specimen slide, long a fixture in the geology laboratory, is remarkably well adapted for use by those botanists interested in making detailed studies of seeds or small fruit. Such slides, often referred to as "Cushman Foraminiferal Slides", are 1″ x 3″ or 1″ x 4″ rectangles of laminated cardboard into which circular or rectangular cavities of various depths and sizes have been cut. Standard diameter for circular cavities is 12.5 mm; standard dimensions for rectangular cavities are 45 mm x 20 mm. Depths ranging from 1 to 3 mm may be ordered for either circular or rectangular depressions. The floor of the cavities may be plain black (see figures 2, 3, 4, 5) or, in the rectangular type, may be black with a white grid of 60 numbered squares (see figure 1). Thus, in the latter type, as many as 60 separate achene or seed specimens could be mounted upon one slide. The lightness of the cardboard slides is a factor of great value in that samples prepared in this way may, after celluloid slide covers are attached, be easily glued to herbarium sheets. If, on the other hand, a separate seed collection is desirable, a large number of slides may be stored in a small space. All of the above described slides, together with slide covers and slide clips, may be obtained from the W. H. Curtin Company, Houston, Texas or New Orleans, Louisiana.

The micropaleontologist's method of preparing specimens of small fossils is similarly adaptable to botanical work. The

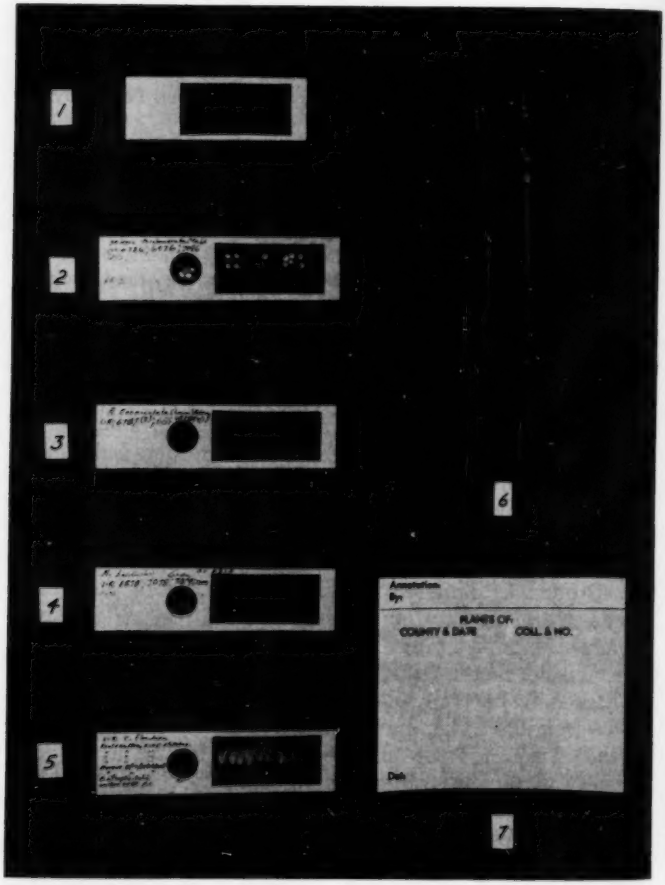

PLATE 1254. Fig. 1. The 1″ x 3″ micropaleontological slide with a grid-depression 3mm deep (Curtin 14402H). Fig. 2. The 1″ x 4″ micropaleontological slide (Curtin 14405) with circular and rectangular depressions 2 mm deep. Specimen mount of *Scleria triglomerata* Michx. Fig. 3. Slide same model as 2. Specimen mounts of achenes of *Rhynchospora corniculata* (Lam.) A. Gray. Fig. 4. Slide same model as 2. Specimen mounts of achenes of *Rhynchospora baldwinii* A. Gray. Fig. 5. Slide same model as 2. Specimen mounts of achenes of *Cacalia floridana* A. Gray, *C. atriplicifolia* L. Fig. 6. Camel-hair brushes needed for achene work. Fig. 7. A 3 ½″ x 4 ¼″ label with ½″ of the top reserved for annotation.

microfossils are "picked" individually from sample trays by means of a small, water-moistened, camel-hair brush, then transferred to a slide on which the worker has placed a small drop of glue (usually gumtragacanth in water). A similar brush may be used to apply the glue to the slide cavity. The specimen is then gently placed on the drop of glue which promptly takes it up and, nearly as promptly, dries. The glue is moderately strong but is quickly soluble in water. Therefore, should future studies demand, specimens may be easily extracted from the mount by teasing them loose with a moist brush; this could be done repeatedly with a minimum of damage either to specimen or slide.

Celluloid strips may be cut to a size appropriate for covering the slide cavities. The slides, plus covers, may be inserted into aluminum slide holders (clip-like structures measuring 76.5 mm x 28.0 mm) which hold the cover-slips in place.

Collection numbers of specimens may be entered on the elevated, white surface of the slide; or, if a numbered grid type of slide is being used, the corresponding collection numbers may be entered in a separate card file.

The slides, slide covers, and clips described above (also see the Curtin and Company catalogue for details) are ideal for storage of a large number of specimens within a small space.

2. *Specimen Labels with Built-in Annotation Slips.* — Modern revisions of taxa entail the laborious annotation of large quantities of herbarium specimens. Thus, considerable valuable time is expended solely upon the chore of attaching annotation labels to herbarium sheets. Often, if the specimen is bulky, the worker has difficulty in finding sufficient space on the sheet to place his annotation. Such expenditures of time could become unnecessary if label size were increased to have the locality label and annotation label as one unit. The extra width thus provided to the label is also advantageous in that the larger label tends to "slip" far less during typing. Indeed, space for more than one annotation could be added to a label; one inch of additional width would provide space for two annotations. — ROBERT KRAL, VIRGINIA POLYTECHNIC INSTITUTE.

Volume 62, No. 738, including pages 145-174 was issued July 8, 1960.

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